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Authors
Alvarez, Camila Huerta
McGee, Julius Alexander
York, Richard

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Is Labor Green?
A Cross-National Panel Analysis of Unionization and Carbon Dioxide Emissions

Camila Huerta Alvarez, Julius Alexander McGee, and Richard York

Abstract: In this article, we assess whether unionization of national workforces influences growth in national carbon dioxide (CO_2) emissions per capita. Political-economic theories in environmental sociology propose that labor unions have the potential to affect environmental conditions. Yet, few studies have quantitatively assessed the influence of unionization on environmental outcomes using cross-national data. We estimate multilevel regression models using data on OECD member nations from 1970 to 2014. Results from our analysis indicate that unionization, measured as the percentage of workers who are union members, is negatively associated with CO_2 emissions per capita, even when controlling for labor conditions. This finding suggests that unionization may promote environmental protection at the national level.

Keywords: carbon dioxide emissions, political-economy, treadmill of production, unions

In light of the severe consequences that anthropogenic climate change is likely to have on societies and ecosystems (IPCC 2014), and the fact that carbon dioxide (CO_2) emissions are the largest contributor to climate change, research on the social forces that influence CO_2 emissions, most of which stem from fossil fuel combustion, is essential. Previous cross-national research on structural drivers has demonstrated links between CO_2 emissions and demographic and political-economic factors such as the scale of economic activity as measured by gross domestic product (GDP), population, industrialization, urbanization, and world-system position (see, e.g., Ergas and York 2012; Greiner and McGee 2018; Jorgenson and Clark 2012; Jorgenson et al. 2010; Rosa et al. 2004, 2015; York 2008; York et al. 2003a, 2003b). However, a gap in this research is a quantitative assessment of how the structure of labor relations—an important aspect of industrial and agricultural production processes—is connected with CO_2 emissions.

The treadmill of production (ToP) (Gould et al. 2008; Schnaiberg 1980), one of the predominant theories aiming to explain the forces behind environmental problems, argues that capital, state, and labor work together toward economic growth, which serves to expand resource consumption and waste production, thereby exacerbating environmental problems. The treadmill metaphor refers to the processes set in motion by corporate efforts to expand profits via technological development and increased production and consumption. These processes lead to unemployment, due to mechanization, and environmental degradation stemming from growth in industrial activities. The loss of jobs and pollution necessitate further expansion of production to provide new jobs and fund environmental cleanup and protection efforts. Thus, societies are on a "treadmill," where they must keep running to stay in place—that is, the economy must continually grow to maintain jobs and address the problems, social and environmental, created by growth in the first place.

Some scholars have developed a nuanced approach to understanding the ToP that suggests that, although organized labor sometimes serves to accelerate the treadmill, it also can decelerate the treadmill as labor unions (hereinafter unions) work to improve workers' health and quality of life (Obach 2002, 2004a, 2004b). Yet, to our knowledge, only one study has assessed the influence of unions, along with other structural variables, on CO_2 emissions at the cross-national level: Timmons Roberts and colleagues (2003) found unionization rates to be negatively correlated with CO_2 emission intensity in nations, but they rely on cross-sectional data. Other studies have examined unions and environmentalism through interviews and historical documents but do not systematically assess large-scale patterns in the environmental consequences of unions (see Dewey 1998; Dreiling 1998; Kojola 2017; Mayer 2009; Obach 2002, 2004a). Therefore, it is worthwhile to assess whether unionization has measurable consequences on CO_2 emissions at the national level.

Unions can influence anthropogenic CO_2 emissions in various ways. They are a place for political advocacy and can play an important role in economic and management decisions through collective bargaining, thereby redistributing capital and resources to limit capital accumulation and promote generalized social benefits, including environmental protection (Obach 2002, 2004a, 2004b). However, more research is needed to assess whether unions have broad structural effects on environmental outcomes. This article fills this gap by theorizing how labor may affect environmentally important actions and by providing an empirical assessment of whether unionization rates are connected with environmental problems. Specifically, we use multilevel analysis of 34 OECD countries from 1970 to 2014 to assess whether the percentage of workers who belong to unions in nations is associated with CO_2 emissions per capita.

Literature Review

The ToP is one of the most influential theoretical frameworks in environmental sociology, and focuses on the role of political-economic dynamics in connection with environmental problems. Allan Schnaiberg (1980) introduced the ToP as a structural analysis of environmental problems in which he incorporates political-economic theories including neo-Marxist monopoly capitalism to explain the rise of environmental degradation (Foster and York 2004). Several colleagues including Ken Gould, Adam Weinberg, and David Pellow worked with Schnaiberg to revisit the ToP over the years (Gould et al. 2004, 2008; Pellow et al. 2000; Schnaiberg and Gould 1994; Schnaiberg et al. 2002). The ToP is based on the recognition that economic growth requires large amounts of natural resources, produces large quantities of waste, and thus causes environmental problems. The nature of the capitalist system is centered on production expansion, and profits are used for capital growth. To maximize profits, capital tries to suppress worker's rights, environmental protection, and social service programs. Schnaiberg (1980) contextualizes the rise of environmental problems after World War II, noting that economic changes in most industrial nations encourage vast accumulation of capital while extracting natural resources and destroying the environment. These capitalist processes are being applied at accelerated rates, with technologies needing more natural resources and energy consumption. As the name suggests, the treadmill illustrates how these economic processes continue on a seemingly endless pursuit.

The ToP has developed over time, reflecting political-economic changes of the processes behind environmental degradation. Most notably, the initial ToP from 1980 did not carefully consider globalization or the distinctive dynamics specific to particular localities (Buttle 2004). Although the original focus of the ToP was on the United States after World War II, the logic of the treadmill can be applied to the dynamics of global corporate capitalism. Since 1980, scholars have applied the theory to address issues of globalization by incorporating national and international divisions of labor, as well as the divide among countries in which production and consumption take place. For instance, recent work on the ToP examines how government officials promote neoliberal policies of "free trade" that push environmental degradation from rich nations to poor nations (Gould et al. 2008). Andrew Jorgenson and Brett Clark (2009) argue that the ToP in conjunction with the ecologically unequal exchange theory help explain how the structure of international trade works to benefit wealthy nations and destroy the environments of poor nations. There is still room for theoretical expansions of the ToP to incorporate global capitalist dynamics of foreign investments and transnational trade (Jorgenson and Clark 2012).

There are various components to the ToP, but most relevant here is the theorization of the alliance among the three key institutional actors driving the treadmill: the state, capital, and big labor. The alliance is also referred to as the growth coalition, where the state, capital, and labor are working to accelerate the treadmill, since these actors each benefit from economic growth but do not have the same power, motivations, or general interests. Schnaiberg (1980) identifies the state, capital, and labor as institutional actors that have cooperative and competitive relationships toward production expansion. Capital plays the central role in production expansion and environmental harm. Even though capital relies on the state and labor to maintain the ToP, it undermines the credibility of the state and labor when the treadmill system leads to unemployment and pollution. For instance, the state has a cooperative relationship with capital by supporting treadmill expansion through policies that encourage economic growth, such as business-friendly tax legislation and deregulation (Schnaiberg and Gould 1994). However, the state is left in a difficult position when government officials are held responsible because of public dissatisfaction about the undesirable results of the treadmill. Schnaiberg and Gould (1994) argue that the state, because it functions more as a force for the elite class, typically will not oppose capital. Environmental sociologists argue that legislation aimed at protecting the environment has had only very modest effects on reducing environmental impacts in the production process, in part because the state typically does not challenge corporate power (Foster et al. 2010). Recycling is an example of the inadequacy of state-supported environmental protections in the treadmill system: its expansion in the United States and other nations did little to conserve energy and resources and did not provide high-paying jobs (Pellow et al. 2000).

Big labor is theorized to play an important role in the treadmill. Schnaiberg (1980) saw more potential for unions compared to the state when it comes to defying capital. Capital has a direct relationship with labor to produce commodities through labor power and technologies.

Furthermore, capital seeks to maximize profits and worker productivity by lowering wages and increasing technological use. In contrast, labor seeks to increase workers' wages and employment. These labor demands put limits on capital, opening up the potential for labor to counter the exploitative tendencies of corporations. Although a goal of unions is to increase laborers' income, potentially making them supporters of the treadmill, unions also advocate for better working conditions (e.g., less exposure to environmental hazards), which require employers to address the inherent social cost of maximizing profits. The rise of global capitalism pushes governments and global organizations to support a structure of international trade in which capital displaces union jobs in rich nations to nonunion jobs in poor nations. Indeed, the number of unions has been declining since the 1970s because of globalized labor markets, international trade, and anti-union laws (Blanchflower 2007). In general, the state assists capital's interests in these actions by dismantling regulations and protections for worker interests (Oliver 2005). The treadmill system develops new technologies to expand production and reduce the power of labor by de-skilling jobs and replacing workers with machines. Thus, unions' ability to advocate for higher wages and better working conditions has declined drastically over time, shifting their role within the ToP (Buttel 2004; Gould et al. 2008; Schnaiberg et al. 2002).

Despite their decline in power, unions remain involved in workplace decisions, which can lead them to be critical actors on the production process and subsequently on the environment. Unions and environmentalists engage in similar economic battles against big, centralized capital interests. In fact, unions may serve to challenge the ideological forces that perpetuate the treadmill (Gunderson 2017). In the initial ToP, organized labor and capital are identified as having a competitive relationship for the distribution of resources. As Obach (2004b) explains, unions can decelerate the treadmill by voicing concerns about environmental quality through collective bargaining actions and by redirecting resources into social and employee needs (e.g., social programs, wages, public services, health care services) instead of industrial expansion. Without these oversights, capital's elite class is more likely to engage in environmental and social exploitation.

The history of unions and environmentalism demonstrates the strategies that unions can deploy to resist capital's drive for endless growth. Obach (2004b) extends the ToP by showing that unions sometimes use several mechanisms to slow the treadmill of production. First, unions can encourage different types of labor practices. Unions often oppose corporations' pushes for automation. For instance, during the 1950s and 1960s, the American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) voiced concerns over the replacement of workers through technology by passing resolutions against automation. Furthermore, the AFL-CIO pursued efforts to compensate workers who lost their jobs to technology. Second, unions can advocate for redistributing resources to social programs. Unions slow the treadmill by struggling to ensure that a share of profits go to workers' benefits such as health insurance and higher wages (Obach 2004b). The treadmill slows down if surplus resources are placed toward social needs instead of profit expansion (Schnaiberg 1980).

Third, unions can emphasize other factors instead of solely profit. Unions can slow the treadmill by advocating for resources to be put toward improving working conditions. Organized labor has been influential on health and safety concerns, advocating for members' environmental safety in the workplace (Silverman 2006). Unions have pushed for environmental reform by raising awareness of pollution in the workplace. In the United States, for example, the United Steelworkers conducted its own safety investigations on smog's impact on workers (Dewey 1998), and the United Farm Workers of America, led by Cesar Chavez at the time, followed Rachel Carson's work to expose agricultural pesticides' harm to workers and consumers. Subsequently, growth in public attention around occupational safety was followed by rising concerns on community safety from pollution. Unions outside the United States have advocated for the environment through the workplace and beyond. For example, the Spanish Comisiones Obreras is actively involved in occupational health and safety concerns at the international level (Stevis 2011). In Italy, unions fought against environmental industrial hazards and helped create the country's public health system and labor statute (Barca 2012).

Although work for environmental justice and protection for workers, such as occupational and community safety, does not directly reduce CO_2 emissions, a large part of pollution that harms workers derives from the use of fossil fuels. Thus, unions collectively working to reduce pollution exposure tend to pressure industries to decrease their use of fossil fuels, which in turn may help suppress the growth rate of CO_2 emissions. Furthermore, Roberts and colleagues (2003) argue that (globally) the least efficient producers tend to be the most politically oppressive and that unions are the key to carbon efficiency.

Finally, unions have a history of supporting environmental stewardship. Labor activists and scholars have shown that, despite potential tensions, there are many instances of union collaborations with environmentalists and that unions are a place for environmental advocacy (Dewey 1998; Mayer 2009). In the 1970s, the Australian Builders Labourers Federation was a key supporter of protecting the environment from unsustainable practices by withholding their labor in the "green bans" (Snell and Fairbrother 2010). Furthermore, the International Confederation of Free Trade Unions decided to include the "environment" within its Working Party on Health, Safety, and Environment (Silverman 2006). Unions from around the world have gathered to discuss the environment and expand workers' rights to include environmental rights (Rathzel and Uzzell 2011). Based on the ToP and on Obach's (2004b) understanding of labor's role in the treadmill, there are good reasons to expect unions to play a critical role in environmental politics. Central traits of unions, including the fundamental concern for organizing solidarity for better working conditions, links workers collectively with environmental issues.

Despite the potential for labor-environment coalitions, there are instances around the world in which unions have worked against environmental protection. Unions, seeking to protect jobs and wages, have often helped spur the treadmill by supporting economic initiatives pushed by corporations. Studies find that workers, since they depend on their employers for jobs, can be blackmailed into supporting capital interests in industry (i.e., workers are under pressure to prioritize their individual interests over the collective union's interests), which potentially sets up an antagonistic relationship between labor and environmental groups (Kazis and Grossman 1982). Specific industrial sectors such as road construction and resource extraction often take the position that "environmentalism kills jobs" or support weak ecological modernization efforts, which is often in conflict with other union organizations that support environmental protection and blue-green coalition building (Estabrook 2007; Felli 2014; Rathzel and Uzzell 2011). This can encourage public leaders and the media to use "jobs versus the environment" rhetoric, even though research shows that environmental protection does not typically contribute significantly to job losses (Bell and York 2010; Freudenburg et al. 1998; Matthews 2011; Kojola 2017).

An example of the antagonism between workers and environmentalists is the battle over protection for the northern spotted owl in the Pacific Northwest of the United States. Timber firms worked to subvert and undermine environmental protections to allow for continued clear-cutting of ancient forests (the owl's habitat) by claiming economic necessity (Foster 1993). Here, the timber industry framed the issue as one in which environmentalists were trying to push laws that would lead to job losses, thus setting up the idea that the conflict was between workers and environmentalism (Freudenburg et al. 1998). Herb Thompson and Julie Tracy (1995) demonstrate a similar divide between environmental conservationists and timber workers in Western Australia. Similarly, some unions in Spain support mountaintop removal in the Laciana Valley, arguing it will bring more jobs (Cabrejas 2012). A more recent example of the battle between workers and environmentalists is the ongoing debate over the Keystone XL pipeline in North America, where some unions supported the construction for jobs and economic growth and withdrew their support for the BlueGreen Alliance (Kojola 2017). Nontheless, recent research found that US union households had equal strength of environmental concerns as nonunion households, even in weak economic periods, demonstrating that union members do not necessarily see a tension between supporting workers' interests as well as environmental protection (Kojola et al. 2014).

It is important to recognize that the effects of unions are mediated by their connections with various aspects of working conditions. Some scholars have examined the connection between working hours in the typical week, and CO_2 emissions (Knight et al. 2013) and energy consumption (Fitzgerald, Jorgenson, and Clark 2015) at the cross-national level, finding that more hours is connected with higher emissions and consumption. Additionally, Jared Fitzgerald, Juliet Schor, and Andrew Jorgenson (2018) found a similar connection between working hours and emissions across the United States. Since unions can affect working hours, these findings may be connected with unionization. This body of research suggests it is important to control for various aspects of working conditions when assessing the effects of unionization.

Clearly, more research is needed to assess the general connection between unions and the environment—especially at the global level, because most studies focus locally (Silverman 2006). At the state level in the United States, Thomas Dietz and colleagues (2014) found that unionization did not affect CO_2 emissions when controlling for population, affluence, and degree of support for environmentalism. However, as noted earlier, the issue lacks cross-national research. Based on the ToP, we argue that the unionization of workers is a gauge to evaluate the strength of labor. In the above-reviewed literature, we identify several key reasons to expect CO_2 emissions to be lower in nations where labor is more powerful than in nations with disempowered labor: (1) unions often resist mechanization in the production process, and mechanization is energy (and therefore CO_2) intensive; (2) unions work to protect workers' health from exposure to pollution, which may lead them to support regulations on fossil fuel, chemical, and other energy-intensive sectors; and (3) more broadly, unions have the potential to resist the power of corporate actors that drive the treadmill to endlessly expand production and consumption despite social and environmental harm. None of these are singular mechanisms; rather, they are tendencies that may structurally affect national fossil fuel consumption and, therefore, CO_2 emissions.

Here, we employ union membership as an indicator of union strength to evaluate the influence of unionization on CO_2 emissions per capita. Our union density measurement is commonly employed by other researchers (Sano and Williamson 2008). It does not include those individuals who are not working or actively looking for work, such as prisoners and students. Scholars have used similar data to those we use to investigate the connections between union density and various social, economic, and institutional factors (Checchi and Visser 2005; Sano and Williamson 2008; Scruggs and Lange 2002).

Hypotheses

Based on the discussion so far, we hypothesize two alternative outcomes regarding the relationship between union density and CO_2 emissions. Each hypothesis is based on the following question: Is a nation's union density associated with CO_2 emissions per capita?

H1: Nations with higher levels of unionized labor have lower levels of CO_2 emissions per capita.
H2: Nations with higher levels of unionized labor have higher levels of CO_2 emissions per capita.

H1 is derived from Obach's (2004b) extension of the ToP and assumes that nations with highly unionized workforces will experience greater opposition to the treadmill, which will suppress CO_2 emissions by reducing the reallocation of profits into fossil-fuel-intensive processes. Inversely, H2 is based on the implication in the original ToP formulation (Schnaiberg 1980) that unions operate as a facet of the treadmill, and nations with high union density will therefore have relatively high CO_2 emissions because big labor helps drive continual intensification of production. Note that each hypothesis is about the general environmental implications of the workforce unionization across nations and does not address the specifics of union participation in each nation. Furthermore, union strategies are not monolithic and are often adversarial to one another. Also, we are assessing not whether unions take specific actions that affect CO_2 emissions but rather whether the degree of unionization in nations is connected with emissions through multiple potential routes. Union density may be interpreted as a general indicator of the relative strength of labor; thus, any estimated effects from unionization may not be directly traceable to specific acts of unions themselves but may rather reflect how the power of labor affects production processes more generally. Therefore, we are cautious with our interpretations, since both hypotheses are about the average consequences of unionization in nations.

Additionally, since we are not, of course, using experimental data, we cannot establish causality with high confidence (this is a limitation of nearly all sociological research, since sociologists rarely work with experimental data). Rather, our models assess whether the associations that are expected from the processes proposed by theory exist in the data. Therefore, in the interpretation of our results, the terminology of cause and effect does not mean that statistical analyses alone are sufficient to establish such relationships but rather means that the associations that we find fit with theorized causal processes. The theorized processes discussed earlier are not mechanistic but rather structural and diffuse (i.e., unionization may promote or suppress processes leading to CO_2 emissions through a variety of routes). Thus, theory suggests that unionization creates a context that shapes processes that influence CO_2 emissions. In this, the connection between unionization and CO_2 emissions is theorized to be more of a formal (structural) cause than an efficient one, although unions may in some instances specifically push for environmental reforms and thereby have a direct, efficient influence.

Data and Methods

We use multilevel regression models to assess the association between union membership rates and growth in CO_2 emissions per capita using cross-national, time-series data spanning from 1970 to 2014 for the 34 nations in the Organization for Economic Cooperation and Development (OECD).[1] We focus on OECD nations because they have consistent and reliable data on union membership, which is not the case for most other nations. Because we focus on OECD nations, we are only assessing the effects of union membership in relatively affluent, industrialized economies. We chose 1970 to 2014 to allow for the widest number of observations, but some models cover only 1991 to 2014, since some of our independent variables were not recorded before this time. We end our time frame in 2014 because that is the most recent year for which data are available for the dependent variable, CO_2 emissions per capita. All data are from the World Bank's World Development Indicators (WBG 2018), with the exception of the data on union membership and working hours, which were obtained from the OECD (2018). We include as control variables the factors that other studies have shown to be most consistently connected with CO_2 emissions (e.g., Ergas and York 2012; Jorgenson et al. 2010; Joregonson and Clark 2012; Knight et al. 2013; York 2008; York et al. 2003a, 2003b). We also include variables that characterize the workforce, since these may be connected with unionization. Summary statistics for all variables are presented in Table 1.

We proceed with multilevel modeling because, first, the data have a hierarchical format with yearly estimates (level 1) nested within countries (level 2). We expect there to be significant differences among countries, and the multilevel format can examine this variation. Second, multilevel modeling is more flexible with unbalanced panel data (Hox 2010; Singer and Willett 2003). We chose to proceed with a two-level random intercept model. We estimate the model (in which *t* represents year and *i* represents country) as follows:

Micro:

$$CO2pc_{ti} = \beta_{0i}x_{0ti} + \beta_1 union_{ti} + \beta_2 GDPpc_{ti} + \beta_3 GDPpc^2_{ti} + \beta_4 age\_dep_{ti} + \beta_5 urban_{ti} + \ldots + \beta_k year2014_{ti} + e_{0ti}$$

Macro:

$$\beta_{0i} = \beta_0 + \mu_{0i}$$

Combined model:

$$CO2pc_{ti} = \beta_0 + \beta_1 union_{ti} + \beta_2 GDPpc_{ti} + \beta_3 GDPpc^2_{ti} + \beta_4 age\_dep_{ti} + \beta_5 urban_{ti} + \ldots + \beta_k year2014_{ti} + e_{0ti} + \mu_{0i}$$

Level 2: $[\mu_{0i}] \sim N(0, \sigma^2_{u0})$
Level 1: $[e_{0ti}] \sim N(0, \sigma^2_{e0})$

Table 1 ■ Descriptive Statistics of All Variables

	mean	sd	min	max	n
CO_2 emission per capita	9.500	4.832	1.223	40.590	1148
Union density	37.718	21.532	5.291	92.468	1148
GDP per capita	\$32,318.53	\$17,266.45	1,815.02	108,577.40	1148
Age dependency ratio	51.936	7.170	36.323	100.819	1148
Urbanization (%)	75.244	11.339	38.234	97.818	1148
Working hours	1757.1	202.2	1362.1	2422.0	916
Unemployment (%)	7.65	3.99	1.78	27.47	701
Industrialization (%)	26.678	5.824	10.983	43.543	701
Part-time (%)	24.88	8.99	4.96	46.21	627
Wage and salaried workers (%)	82.339	8.253	45.206	93.471	701

Dependent Variable

CO_2 emissions per capita: emissions stemming from the combustion of fossil fuels (including solid, liquid, and gas fuels, as well as gas flaring) and the production of cement (in metric tons per capita).

Independent Variables

Unionization: the percentage of the workforce that is unionized. This is our main variable of interest. The OECD provided union density measurements from two sources: administrative and survey. The availability of the measurements varied between countries. For example, the United States offered only survey data while Spain offered administrative and survey. In nations that have both, the correlation between administrative and survey data is very high (over 0.99). To maximize the coverage of the union density variable, we took the average of the administrative and survey measurements if both were available. If only one measure was available, we took the available measurement.

GDP per capita (in thousands, constant 2010 US$): the connection between economic growth and CO_2 emissions is well established. We include a quadratic (squared) version of GDP per capita to assess whether there is a nonlinear relationship between economic growth and emissions.

Urbanization: the percentage of population living in urban areas. Urbanization is an indicator of modernization and development and has been linked to CO_2 emissions in several studies.

Age dependency ratio: the ratio of people under 15 and over 64 of age to those aged 15 to 64. Since age structure is connected with workforce participation, this is an important control variable.

Unemployment: the percentage of the workforce that is unemployed. The level of unemployment is likely to affect both the power of labor and the level of production, so it is necessary to incorporate the unemployment rate in our models.

Employed in industry: the percentage of the workforce employed in the industrial sector. Since unionization is typically highest in the industrial sector, it is necessary to control for the share of the workforce in this sector.

Working hours: the average annual working hours for the workforce. Previous research (Knight et al. 2013) demonstrates that higher working hours is connected with higher emissions. Hours calculated include all types of workers including full-time, part-time, part-year, and overtime.

Part-time workers: the percentage of workers working less than 30 per week. We include part-time workers as a labor condition control, because part-time work captures nonstandard employment. Part-time work does not include the benefits and stability of full-time employment. This variable was provided from the World Bank and is estimated by the International Labor Organization.

Wage and salaried workers: the percentage of workers with "paid employment jobs" with explicit or implicit employment contracts. Wage and salaried workers captures the type of economy. A high proportion of wage and salaried workers indicates a formal economy, while a lower number indicates an informal economy. This variable was provided from the World Bank and is estimated by the International Labor Organization.

Table 2 ■ Multilevel Regression Results of Factors Influencing CO_2 Emissions per Capita.

Variable	Model 1 (1970–2014)	Model 2 (1970–2014)	Model 3 (1991–2014)	Model 4 (1991–2014)
Time (level 1) variables				
Union density (%)	—	–.028 (.007)***	–.046 (.012)***	–.033 (.012)**
GDP per capita (in thousands, constant 2010 US$)		.207 (.026)***	–.016 (.035)	.017 (.031)
(GDP per capita)^2		–.002 (.000)***	.001 (.000)**	.000 (.000)
Age dependency		–.072 (.011)***	–.084 (.022)***	–.028 (.020)
Urbanization (%)		.129 (.014)***	.099 (.022)***	.082 (.023)***
Working hours		—	–.002 (.001)	—
Unemployment (%)			–.033 (.019)	
Industrial work (%)			.184 (.031)***	.261 (.027)***
Part-time (%)			.053 (.015)***	.054 (.014)***
Wage and salaried workers (%)			.119 (.022)***	.079 (.022)***
Year dummies				
1971	—	–.257 (.434)	—	—
1972		–.053 (.441)		
1973		.273 (.443)		
1974		–.180 (.444)		
1975		–.797 (.434)		
1976		–.665 (.446)		
1977		–1.008 (.438)*		
1978		–.680 (.436)		
1979		–.532 (.444)		
1980		1.101 (.434)*		
1981		–1.774 (.443)***		
1982		–2.016 (.455)***		
1983		2.486 (.448)***		
1984		–2.370 (.453)***		
1985		–2.393 (.458)***		
1986		–2.469 (.462)***		
1987		–2.768 (.462)***		
1988		–2.575 (.473)***		
1989		–2.346 (.475)***		
1990		–2.712 (.477)***		
1991		–2.611 (.481)***		

Table 2 ■ Continued.

Variable	Model 1 (1970–2014)	Model 2 (1970–2014)	Model 3 (1991–2014)	Model 4 (1991–2014)
Year dummies (cont.)				
1992	—	–2.753 (.478)***	–.156 (.309)	–.156 (.305)
1993		–2.698 (.480)***	–.004 (.318)	.491 (.308)
1994		–2.560 (.483)***	.124 (.322)	.156 (.316)
1995		–2.591 (.480)***	–.018 (.293)	.061 (.293)
1996		–2.316 (.491)***	.415 (.295)	.538 (.294)
1997		–2.864 (.502)***	.195 (.298)	.308 (.293)
1998		–3.048 (.500)***	–.002 (.297)	.079 (.296)
1999		–2.847 (.523)***	–.133 (.315)	.154 (.313)
2000		–2.960 (.527)***	–.550 (.325)	–.108 (.322)
2001		–2.948 (.528)***	–.444 (.332)	.086 (.327)
2002		–3.054 (.536)***	–.493 (.343)	.135 (.334)
2003		–3.029 (.539)***	–.190 (349)	.414 (.342)
2004		–3.001 (.552)***	–.384 (.361)	.299 (.352)
2005		–3.254 (.559)***	–.725 (.373)	.009 (.364)
2006		–3.216 (.567)***	–.666 (.388)	.127 (.376)
2007		–3.389 (.581)***	–1.054 (.403)**	–.169 (.389)
2008		–3.611 (.576)***	–1.137 (.406)**	–.264 (.390)
2009		–4.215 (.570)***	–1.538 (.406)***	–.587 (.393)
2010		–3.928 (.575)***	–1.022 (.417)*	–.084 (.404)
2011		–4.314 (.578)***	–1.464 (.423)**	–.519 (.411)
2012		–4.539 (.582)***	–1.705 (.431)***	–.734 (.418)
2013		–4.620 (.582)***	–1.696 (.436)***	–.727 (.425)
2014		–4.946 (.590)***	–2.115 (.449)***	–1.084 (.436)*
Constant	9.141 (.829)***	3.612 (1.554)*	–4.097 (3.982)	–9.900 (3.011)**
Variance terms				
σ^2_{e0}	3.137	1.885	0.448	0.529
σ^2_{u0}	23.248	19.17	11.386	13.657
N (total)	1148	1148	519	555
Number of countries	34	34	33	34

* p < .05 | ** p < .01 | *** p < .001

Note: For Model 2, the reference category for the year dummies is 1970.
For Models 3 and 4, it is 1991.

Results

The logic of multilevel modeling is to fit a variety of models, beginning with the unconditional means. Our goal is to assess the extent to which unionization is correlated with emissions independent of traditional drivers of emissions and other indicators of workforce participation. Results from the multilevel analyses are presented in Table 2. The null model (Model 1) has a fixed effect (referred to as the constant/intercept) of 9.141, indicating the overall average of CO_2 emissions per capita across all countries and observations. The null model, and all subsequent models, have two random effects: first, the within-country variance (σ^2_{e0}) is 3.167, and second, the between-country variance (σ^2_{u0}) is 23.248. We calculated the intraclass correlation coefficient to estimate the amount of variance explained at level 2 (i.e., the country level). For the null model, the intraclass correlation coefficient is about 88.11 percent.

We added predictors based on our theory-driven hypotheses to Model 2, which includes unionization and other important control variables indicated from previous research, including GDP per capita, age dependency ratio, and urbanization. For Model 2, to maximize the number of observations included in the models, we used only controls that have good data coverage. Thus, Model 2 includes data from 1970 to 2014. Model 2 has a fixed intercept of 3.612 and includes year dummies to control for period effects. The effect of union density is negative and statistically significant, demonstrating that an increase in union density is associated with a decrease of CO_2 emissions per capita while controlling for other variables. Model 2 further demonstrates that an increase in age dependency ratio (e.g., working-age population) is associated with a decrease in CO_2 emissions per capita. The results also show that an increase in urbanization corresponds with an increase in CO_2 emissions per capita. Finally, GDP per capita has a quadratic relationship. Results from the likelihood ratio test showed that Model 2 is superior to the null model.

To further assess the effects of unionization, we include additional labor controls of working hours, part-time workers, wage and salaried workers, unemployment, and industrialization in Model 3. Average annual working hours gauges that of a nation's workforce and includes all types of workers. To control for the stratification among type of work, we include the percentage of part-time workers and of wage and salaried workers. For example, US annual working hours is higher than average. However, the United States also has a high number of involuntary part-time workers who would prefer to work more hours (Lambert et al. 2012). Model 3 includes percentage of unemployment and workers in the industrial sector.

Model 3 includes roughly half the observations from the previous models, covering only 1991 to 2014, due to missing data on the additional control variables. The number of countries represented declined to 33, because Iceland does not provide data on annual working hours. In Model 3,[2] unions, age dependency ratio, and urbanization all maintain their direction and significance. Only the quadratic term for GDP per capita is significant. Among the labor control variables, Model 3 indicate that increases in the percentage of workers in industrial jobs is associated with an increase in CO_2 emissions per capita. Furthermore, Model 3 demonstrates that increases in part-time and wage and salaried workers corresponds with an increase in CO_2 emissions per capita. Working hours and unemployment did not have significant effects.

Finally, Model 4 includes only variables that had significant effects in Model 2 or Model 3. All variables except GDP per capita and age dependency ratio remain significant. Model 2 is a parsimonious model with the widest coverage. Model 4 is perhaps the most important model, since it controls for a wide range of factors yet still has reasonable coverage. Model 3 has low coverage compared to Model 1 and Model 4, but it has the most extensive controls. Nonetheless, all the models indicate that unionization has a significant, negative effect on emissions that is independent of other drivers of emissions and other indicators of workforce participation. These findings provide clear support for the hypothesis that nations with more highly unionized workforces have lower CO_2 emissions per capita than nations with a lower proportion of unionized employees (H1), and contradicts the hypothesis that unionization contributes to higher emissions (H2).

Discussion and Conclusion

Previous research demonstrates moments of antagonism between unions and environmentalists (Foster 1993; Kojola 2017). Despite these tensions, unions have played an important role in environmental activism (Dewey 1998; Mayer 2009). Workplaces are where many economic and environmental decisions take place, and unions are institutions that affect environmental conditions. Here, we empirically assessed the connection between the degree of unionization in OECD nations and CO_2 emissions in those nations. Our analysis shows that nations with highly unionized workforces have lower CO_2 emissions than nations with less unionized workforces, controlling for several factors. This finding demonstrates that unions are an important part of understanding anthropogenic drivers of CO_2 emissions, and suggests that unions may have environmentally beneficial effects on production processes. Our analysis demonstrates that global efforts for workers' rights may help efforts to reduce CO_2 emissions and to mitigate climate change.

The treadmill of production theory as further refined by Obach (2004b) provides a framework for explaining why unions mitigate environmental impacts. Unions and environmentalist organizations have a common struggle in fighting the excesses of the global capitalist system. There are a variety of ways in which unions can act as propellers of changes in environmental practices through political advocacy and collective bargaining agreements. Unions are organizations that provide a space for discussions of social and environmental issues. The treadmill slows down if surplus resources are placed toward social needs instead of profit expansion (Schnaiberg 1980), and unions appear to encourage a focus on social benefits. If profits are directed toward the general social good, then there is less opportunity for the elites to reinvest surplus into practices harmful to the environment.

Future research should investigate the nuances of unions and environmental impacts such as the mechanisms within workplace arenas and collective bargaining processes in which workers make decisions that influence the environment. Furthermore, future research should explore case studies in specific nations of the local dynamics among unions and environmental impacts. Our analysis suggests that the strength of labor unions may help mitigate environmental problems by encouraging environmental stewardship, redistributing resources to social programs, and emphasizing factors other than corporate profits.

Camila Huerta Alvarez is a doctoral student in sociology at the University of Oregon. Her research interests include environmental sociology, urban sociology, and quantitative methods. Email: calvarez@uoregon.edu.

Julius Alexander McGee is an assistant professor of sociology at Portland State University. His research focuses on the relationship between inequality and the environment, ecological paradoxes, and critical environmental justice. Email: cjulius@pdx.edu.

Richard York is a professor of sociology and environmental studies at the University of Oregon. He does theoretical and empirical work in environmental sociology, animal studies, and the sociology of science.
Email: rfyork@uoregon.edu.

Notes

1. Latvia joined the OECD in 2016, bringing it to 35 members. We examine the 34 nations that were members as of 2014: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Republic of Korea, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States.

2. An alternative modeling approach is to focus on total rather than per capita emissions. In models not presented here, we estimated STIRPAT (Stochastic Impacts by Regression on Population, Affluence, and Technology) versions of our models, where population was included as an independent variable, total emissions was used as the dependent variable, and all variables were logged (York et al. 2003a, 2003b). These models suggest findings similar to those we present here. For example, in the STIRPAT version of Model 3, unionization has a significant (at the 0.001 level) negative effect on emissions, and population has a coefficient of almost exactly 1.0, indicating that it proportionately scales emissions (which supports the implicit assumption behind using per capita values).

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